

A Comparative Analysis of Lycophyte and Pteridophyte Evolution in the Carboniferous and Permian Flora

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ABOUT THE STUDY

The evolution of plant life during the Carboniferous and Permian periods was marked by significant transitions in flora that shaped modern ecosystems. Among the most important groups to emerge during these periods were the lycophytes and pteridophytes, both of which played critical roles in terrestrial plant evolution. The Carboniferous period, spanning from about 359 to 299 million years ago, was a time of lush, swampy environments with widespread plant life, while the subsequent Permian period, from about 299 to 252 million years ago, saw shifts in climate and ecosystems that influenced plant development. This article examines the evolutionary trajectory of lycophytes and pteridophytes during these two periods, focusing on their morphological, ecological, and reproductive developments.

Lycophytes: Evolutionary trajectories in the carboniferous and permian

Lycophytes, including club mosses and their relatives, are among the oldest vascular plants, originating in the Silurian period. During the Carboniferous, they flourished, dominating swampy environments with large, tree-like forms. The *Lepidodendrales* was the most prominent group, reaching heights of up to 30 meters. These giant lycophytes featured spiral leaf arrangements and specialized vascular tissues, which suited the high-moisture conditions of the time. However, the Permian period brought significant climatic changes, including increased aridity and the formation of supercontinents like Pangaea. As wetter habitats disappeared, lycophytes declined in diversity, giving way to more drought-tolerant plants in drier, open environments.

Pteridophytes: Transition and diversification

Pteridophytes, including ferns, horsetails, and club mosses, experienced significant evolutionary changes during the Carboniferous and Permian periods. The Carboniferous marked a golden age for ferns, with the emergence of tree

ferns and the proliferation of tree-like species such as *Psaronius*. These plants thrived in humid, lowland swamps, contributing to the formation of extensive coal deposits. During this time, pteridophytes diversified in reproductive strategies, developing more spore-producing structures and complex leaf morphologies. However, by the Permian, as drier conditions prevailed, ferns declined, giving rise to more drought-resistant species like *Equisetum*, which adapted to harsher environments by evolving into smaller, more resilient forms.

Comparative analysis of lycophyte and pteridophyte evolution

The evolutionary paths of lycophytes and pteridophytes during the Carboniferous and Permian periods reflect the broader environmental changes of these times. Both groups experienced peaks of diversity during the Carboniferous, when tropical and subtropical climates favored large, moisture-dependent plants. Lycophytes, with their tree-like forms, were particularly prominent in swampy forests, while ferns and horsetails also thrived in these lush environments.

CONCLUSION

The evolution of lycophytes and pteridophytes in the Carboniferous and Permian periods demonstrates the dynamic interplay between plant life and environmental conditions. Lycophytes, once dominant in the moist, swampy forests of the Carboniferous, gradually gave way to smaller forms during the Permian, adapting to drier conditions. Pteridophytes also evolved in response to climate changes, with their reproductive strategies and morphology shifting to better suit more arid environments. Together, these groups represent the complex evolutionary responses to a changing planet, laying the groundwork for the modern flora that would emerge in later periods.